

Analysis of the Appropriate Use Criteria for Coronary Angiography in Two Cardiology Services of Southern Brazil

Luis Sérgio Carvalho Luciano,¹ Roberto Léo da Silva,^{1,2} Ozir Miguel Londero Filho,¹ Leandro Waldrich,¹ Luciano Panata,¹ Ana Paula Trombetta,¹ Julio Cesar Preve,¹ Tammuz Fattah,¹ Luiz Carlos Giuliano,¹ Luiz Eduardo Koenig São Thiago¹

Instituto de Cardiologia de Santa Catarina,¹ São José, SC – Brazil

Hospital Universitário Prof. Dr. Polydoro Ernani São Thiago - Universidade Federal de Santa Catarina (UFSC),² Florianópolis, SC – Brazil

Abstract

Background: Despite its great relevance, there are no studies in our country evaluating the application of the 2012 guidelines for the appropriate use of cardiac diagnostic catheterization.

Objective: To analyze the adequacy of coronary angiography performed in two hospitals in the southern region of Brazil.

Methods: This is a multicenter cross-sectional study, which analyzed indications, results and proposals for the treatment of 737 coronary angiograms performed in a tertiary hospital with multiple specialties (Hospital A) and a tertiary cardiology hospital (Hospital B). Elective or emergency coronary angiographies were included, except for cases of acute myocardial infarction with ST segment elevation. The level of statistical significance adopted was 5% ($p < 0.05$).

Results: Of the 737 coronary angiograms, 63.9% were performed in male patients. The mean age was 61.6 years. The indication was acute coronary syndrome in 57.1%, and investigation of coronary artery disease in 42.9% of the cases. Regarding appropriateness, 80.6% were classified as appropriate, 15.1% occasionally appropriate, and 4.3% rarely appropriate. The proposed treatment was clinical for 62.7%, percutaneous coronary intervention for 24.6%, and myocardial revascularization surgery for 12.7% of the cases. Of the coronary angiographies classified as rarely appropriate, 56.2% were related to non-performance of previous functional tests, and 21.9% showed severe coronary lesions. However, regardless of the outcome of coronary angiography, all patients in this group were indicated for clinical treatment.

Conclusion: We observed a low number of rarely appropriate coronary angiograms in our sample. The guideline recommendation in these cases was adequate, and no patient required revascularization treatment. Most of these cases are due to non-performance of functional tests. (Arq Bras Cardiol. 2019; 112(5):526-531)

Keywords: Coronary Angiography; Coronary Artery Disease/diagnostic imaging; Acute Coronary Syndrome; Percutaneous Coronary Intervention; Multicenter Study; Epidemiology.

Introduction

The management of coronary artery disease (CAD), the leading cause of mortality in the developed world, is based on the use of diagnostic and therapeutic procedures. Six decades after the first selective coronary angiography performed by Dr. Sones under improbable circumstances,¹ coronary angiography remains the gold standard for diagnosis of CAD,² although noninvasive methods have progressively gained some space.³

Advances in medical technology were followed by rising costs, motivating research on cost-effectiveness issues. The identification of the exaggerated use of medical procedures has led to questions about when they will

actually be needed.⁴ In 2011 a significant drop in the rate of inappropriate angioplasties in the American state of New York was observed after the government announced that the payment would be connected to appropriateness. That is, the financial question influenced the selection of patients for angioplasty. Analyses of appropriate use should follow the progression of ways of financing.⁵

In an effort to present criteria for rational use of cardiology services, the American College of Cardiology Foundation, and 11 other medical entities have issued the 2012 guideline for appropriate use of diagnostic cardiac catheterization. This recommendation has the potential to impact clinical decisions, the quality of health care, and health policies through the efficient use of resources.⁶

In Brazil, this issue was previously studied with the 1999 guideline. An analysis of 145 coronary angiograms in patients with suspected stable ischemic disease was published in 2005. It was also observed that 34.5% of the indications were appropriate, and 65.5% uncertain, or inappropriate.⁷ Also, based on the 1999 guideline, an Italian group studied the indications of 460 coronary angiographies, with no inappropriate angiography in its sample.⁸ Based on the perspectives of the 2012 guideline, the indications of

Mailing Address: Luis Sérgio Carvalho Luciano •

Rua Adolfo Donato da Silva, s/n - Praia Comprida - Secretaria do Serviço de Hemodinâmica do ICSC. Postal Code 88103-901, São José, SC – Brazil
E-mail: luiscl@cardiol.br, luiscl@msn.com

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coronary angiography in New York,⁹ and in a large Canadian cohort of patients suspected of having a stable CAD, were evaluated.¹⁰ The results in the literature are discordant regarding the validation of the guideline, generating concern about its reliability to guide decision-making.¹⁰

The objective of this study is to analyze the appropriateness of coronary angiographies performed in two hospitals in the southern region of Brazil in accordance with the 2012 guidelines.

Methods

This is an observational, cross-sectional, multicenter study. The two centers together perform more than 1,700 procedures per year; one of them is a tertiary hospital with multiple specialties (Hospital A) and the other a tertiary cardiology hospital (Hospital B). All the elective or emergency coronary angiograms were included in the period from May to October 2016. Catheterizations performed in cases of acute myocardial infarction with ST segment elevation were excluded. The information was entered into a database at the time of the procedure. The work was approved by the Research Ethics Committees of the institutions involved.

All indications were classified as appropriate, occasionally appropriate, or rarely appropriate, according to current terminology,¹¹ and following the 2012 guidelines for appropriate use of diagnostic cardiac catheterization. In this guideline, indications are divided into three broad groups: 1. Evaluation of CAD; 2. Evaluation due to conditions other than CAD (valvar, pericardial or cardiomyopathy diseases); 3. Right heart catheterization. The guideline covers 102 possible indications, which were classified by a score that combines evidence-based medicine and practical experience of the members of a technical panel. Each indication received an average score of 1 to 9, being classified as appropriate when between 7 and 9, occasionally appropriate when between 4 and 6, and rarely appropriate when between 1 and 3.⁶

The analysis also included age, sex, clinical status, coronary angiographic findings regarding the presence of obstructive disease, and the treatment proposal.

The clinical picture was simply characterized as an acute coronary syndrome (ACS) or as a stable condition, which included all patients who did not fit the first group. ACS was characterized by presenting with typical chest pain at rest or in progress, associated or not with the electrocardiographic alteration suggestive of ischemia (ST segment depression and/or T wave alteration), and may or may not be associated with changes in myocardial necrosis markers.¹²

In order to check if the recommendation of the guideline adequately predicts the angiographic result and therapeutic perspective, the coronary angiography result was classified according to the extent of the severe CAD, and the treatment proposal for each case was documented.

A reduction of greater than or equal to 50% in the diameter of the left coronary artery trunk (LCT), and greater than or equal to 70% for the other vessels, was considered severe, either by visual angiographic evaluation or by quantitative angiography, with the projection in which the lesion was more severe being chosen.^{11,13}

Patients with severe LCT lesions were classified regardless of the presence of other severe lesions.

The treatment proposal was defined by the hemodynamicist in charge, after coronary angiography, and may be clinical treatment, coronary angioplasty or myocardial revascularization surgery, according to available clinical data and the anatomical result found in the examination.

Data analysis was performed in order to also allow the comparison between two services with different profiles, with Hospital A being a general hospital and Hospital B a reference center for high complexity in cardiology in the state, with a large flow of coronary patients in its emergency service. The two services are provided exclusively by the Unified Health System (SUS).

Statistical Analysis

For data analysis, the IBM SPSS Statistics 23 software (IBM Corp. Released 2015, IBM SPSS Statistics for Windows, Version 23.0, Armonk, NY: IBM Corp.) was used. The results were expressed in numbers and (absolute and relative) proportion, for categorical variables, and in measures of central trend (mean) and dispersion (standard deviation) for continuous variables. The chi-square test was used to study possible associations between categorical variables. For the comparison between continuous variables, the unpaired Student t test was used. The Kolmogorov-Smirnov test was applied to evaluate the sample normality assumption. The level of statistical significance adopted was 5%, considering a 95% confidence interval.

Results

Of the 737 coronary angiograms analyzed, 76.8% were performed at Hospital B, 63.9% in male patients. The mean age was 61.6 years. The indication for coronary angiography was due to ACS in 57.1%, and CAD investigation in 42.9% of the cases. Regarding appropriateness, 80.6% of the coronary angiograms were classified as appropriate, 15.1% occasionally appropriate, and 4.3% rarely appropriate. We observed that 41.2% of coronary angiograms did not show severe CAD, 27.4% severe single-vessel CAD, 17.2% two-vessel CAD, 11.3% three-vessel CAD, and 2.8% severe LCT lesion. The proposed treatment was clinical for 62.7% of the patients, percutaneous coronary intervention for 24.6%, and myocardial revascularization surgery for 12.7% of the cases.

There was no statistically significant difference in the prevalence of male and female patients between the two institutions (Table 1). The mean age was 59.1 years in Hospital A, and 62.3 years in Hospital B ($p < 0.05$).

All patients with ACS have appropriate indication for coronary angiography. In this group of patients there was no statistically significant difference regarding the distribution by gender, coronary angiography result and treatment (Table 2).

Among the stable patients, there was a lower proportion of patients with appropriate indications in Hospital A compared to Hospital B and a higher proportion of occasionally appropriate ones. Among the stable patients, no difference was observed regarding the distribution by gender, outcome and treatment. There was a higher incidence of indication

Table 1 – Distribution of patients between the two institutions according to gender, clinical presentation, classification of appropriate use, coronary angiography result and treatment

		Source				p = 0.132	
		Hospital A		Hospital B			
		Score n = 171	%	Score n = 566	%		
Gender	Female	70	40.9%	196	34.6%	p = 0.132	
	Male	101	59.1%	370	65.4%		
Clinic	ACS	46	26.9%	375	66.3%	p < 0.001	
	Stable	125	73.1%	191	33.7%		
Evaluation of appropriateness	Rarely Appropriate	10	5.8%	22	3.9%	p = 0.084	
	Occasionally Appropriate	61	35.7%	50	8.8%		
	Appropriate	100	58.5%	494	87.3%		
	Normal	90	52.6%	214	37.8%		
Result	Single-vessel	38	22.2%	164	29.0%	p = 0.078	
	Two-vessel	27	15.8%	100	17.7%		
	Three-vessel	12	7.0%	71	12.5%		
	LCT	4	2.3%	17	3.0%		
Treatment	Clinical	122	71.3%	340	60.1%	p < 0.001	
	Angioplasty	31	18.1%	150	26.5%		
	Surgical	18	10.5%	76	13.4%		

ACS: acute coronary syndrome; LCT: left coronary artery trunk. * Statistical significance analyzes performed using the chi-square test.

Table 2 – Distribution of patients with ACS within the two institutions according to gender, result of coronary angiography and treatment

		Source				p = 0.266	
		Hospital A		Hospital B			
		Score n = 46	%	Score n = 375	%		
Gender	Female	19	41.3%	124	33.1%	p = 0.266	
	Male	27	58.7%	251	66.9%		
Result	Normal	10	21.7%	96	25.6%	p = 0.569	
	Single-vessel	12	26.1%	126	33.6%		
	Two-vessel	15	32.6%	81	21.6%		
	Three-vessel	6	13.0%	57	15.2%		
Treatment	LCT	3	6.5%	15	4.0%	p = 0.424	
	Clinical	20	43.5%	188	50.1%		
	Angioplasty	19	41.3%	130	34.7%		
	Surgical	7	15.2%	57	15.2%		

ACS: acute coronary syndrome; LCT: left coronary artery trunk. * Statistical significance analyzes performed using the chi-square test.

for preoperative cardiac surgery exams at Hospital B when compared to Hospital A, and a predominance of CAD investigation at Hospital A (Table 3).

Of the 737 patients, 32 (4.3%) had their coronary angiography classified as rarely appropriate. Of these, 18 cases (56.2%) were related to non-performance of previous functional tests; six (18.8%) were asymptomatic patients or those with stable symptoms who underwent prior revascularization; six (18.8%) were stable asymptomatic

non-cardiac surgery patients with functional capacity ≥ 4 METS; one (3.1%) had known CAD receiving clinical treatment, and with low-risk findings in noninvasive tests, or stable symptoms, and one (3.1%) with mild or moderate aortic valve stenosis of native or prosthetic valve, and asymptomatic regarding valve disease.

Among those classified as rarely appropriate, seven cases (21.9%) had severe coronary lesions but, regardless of the result of the coronary angiography, all patients in this group

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Table 3 – Distribution of patients being investigated for CAD within the two institutions according to gender, assessment of appropriateness, reason for indication, result of coronary angiogram and treatment

		Source			
		Hospital A		Hospital B	
		Score n = 125	%	Score n = 191	%
Gender	Female	51	40.8%	72	37.7%
	Male	74	59.2%	119	62.3%
Evaluation of Appropriation	Appropriate	54	43.2%	119	62.3%
	Occasionally Appropriate	61	48.8%	50	26.2%
	Rarely Appropriate	10	8%	22	11.5%
Reason for Indication	Diagnosis of CAD	97	77.6%	114	59.7%
	Reassessment of CAD	14	11.2%	33	17.3%
	Pre-Op. of Cardiac Surgery	6	4.8%	40	20.9%
Result	Pre-Op. of Non-Cardiac Surgery	8	6.4%	4	2.1%
	Normal	80	64%	118	61.8%
	Single-vessel	26	20.8%	38	19.9%
Treatment	Two-vessel	12	9.6%	19	9.9%
	Three-vessel	6	4.8%	14	7.3%
	LCT	1	0.8%	2	1%
Treatment	Clinical	102	81.6%	152	79.6%
	Angioplasty	12	9.6%	20	10.5%
	Surgical	11	8.8%	19	9.9%

CAD: coronary artery disease; LCT: left coronary artery trunk. * Statistical significance analyzes performed using the chi-square test.

were indicated for clinical treatment. Of the seven patients, in four (57.1%) lesions were observed in vessels of fine caliber (< 2 mm); in two (28.6%), there were distal lesions in vessels of fine caliber, and one (14.3%) underwent coronary angiography due to moderate aortic valve stenosis, being asymptomatic from the cardiological point of view.

In 13.5% of those classified as occasionally appropriate, and in 43.8% of the appropriate, the option was either percutaneous or surgical revascularization.

Discussion

The balance between cost and effectiveness is necessary because funding sources are pressed by increased demand, technology, and consequently, resources. The rational use of these resources is part of the physician's social responsibility.⁴ Even so, many cardiologists believe that angioplasty is beneficial for patients with stable CAD, and the approach continues to be the search for ischemia. It is not surprising that a substantial minority of cardiologists believe that angioplasty and coronary stenting prevent myocardial infarction. These beliefs are seen in practice with poor application of resources: it is estimated that up to half of elective angioplasties may be inappropriate.¹⁴ This reality also applies to diagnostic methods, such as coronary angiography.^{7,9}

Historically there is great international variability in the proper use of diagnostic cardiac catheterization. This issue was studied in more than ten countries between 1987 and

2006, with appropriate use rates between 34.5%⁷ and 91%,¹⁵ with most studies showing rates of appropriation above 72%.¹⁶

Differently from other large multicenter retrospective studies analyzing the 2012 guideline for appropriate use of diagnostic cardiac catheterization,^{9,10} the present study validates the guideline when we relate the adequacy of coronary angiography and the treatment. Another relevant aspect is the possibility of analyzing the characteristics of two institutions with different profiles (general tertiary hospital and tertiary cardiology hospital) within the same micro-region. In addition, although the 2012 guideline still uses the classification of appropriate, uncertain and inappropriate, we chose to use the most current classification of appropriate, occasionally appropriate and rarely appropriate, used in the most recent guidelines.¹¹

We included the cases of ACS in our analysis, which were not included in other studies, because it is the subgroup of patients that accounts for the main difference between the centers studied, and due to the relevance of documenting these institutional characteristics. The cases of ACS do not qualitatively stratify coronary angiography indications, since, in these cases, all of them are classified as appropriate. We observed the expected predominance of these cases in the cardiology hospital (Hospital B), and higher prevalence of stable patients in the general hospital (Hospital A) (Table 1). To analyze the quality of the indications for coronary angiography, the analysis of the subgroup of patients in the CAD investigation was performed.

The results of analysis of a large retrospective cohort with 48,336 patients with suspected stable CAD in the region of Ontario, Canada, were published in 2015.¹⁰ In the Canadian study, rates of 58.2% of appropriate cases, 31% of occasionally appropriate ones, and 10.8% of rarely appropriate cases were observed, which are similar to those found in our sample of patients being investigated for CAD, with 54.7% classified as appropriate, 35.1% occasionally appropriate, and 10.2% rarely appropriate.

Despite the apparent balance in the proportion of indications, while 18.9% of the patients classified as rarely appropriate in the Canadian study underwent revascularization procedures, 100% of the patients so classified in our study were referred for clinical treatment despite the presence of severe coronary lesions. This can be explained by the presence of distal lesions in thin or minor vessels that make clinical treatment the best option in this context. This information validates the application of the guideline in our population, since patients with an indication of rarely appropriate for coronary angiography would not have an indication of treatment of revascularization as a complement to the optimal drug therapy.

Another large retrospective study in the state of New York analyzed the indications of 8,986 coronary angiographies, and found that 24.9% of their cases were classified as rarely appropriate,⁹ a number that is considerably larger than the 10.8% and 10.2% in the Canadian study and in our sample, respectively. To explain why about a quarter of cases were classified as rarely appropriate, it was argued that at the time of coronary angiography, the 2012 guideline for the appropriate use of diagnostic cardiac catheterization had not yet been published. However, the situation is similar to that of the Canadian cohort, which had its coronary angiograms performed between 2008 and 2011, and presented more modest proportions of rarely appropriate coronary angiograms. A significant portion of the rarely appropriate coronary angiographies enters this classification due to non-performance of previous functional tests,^{16,17} a situation that is responsible for 56.2% of these cases in our sample. The performance of functional tests would provide the reclassification of these cases, improving the use of coronary angiography.^{6,17,18}

When we observed the differences between the two institutions involved in the present study, a higher proportion of coronary angiographies with appropriate indication at Hospital B, and a higher proportion of occasionally appropriate at Hospital A (Table 3) were evident in the subgroup of patients being investigated for CAD. The highest proportion of preoperative cardiac surgery tests performed at Hospital B, an indication classified as appropriate by the guideline,⁶ explains part of this difference. The performance of cardiac surgeries in Hospital B, an institution dedicated to cardiology, appears as the main factor for the difference of appropriateness between the two institutions.

The limitations of our study are the reduced size of its sample, which precludes a detailed analysis of each indication of the guideline; and failure to follow patients

for prognostic evaluation related to outcome and treatment. In addition, more than 50% of our sample are cases of ACS, in which invasive stratification is appropriate according to the guideline, limiting the analysis of the quality of the indication in this scenario. The results represent the reality of the patients treated in two public hospitals located in the southern region of Brazil. Further studies are necessary to evaluate the indications of coronary angiography in other contexts and regions of the country.

Conclusion

We conclude that our sample has appropriateness indices similar to those in the literature, with a small rate of rarely appropriate procedures. The guideline recommendation in rarely appropriate cases was adequate in our study, with no patients in this group requiring revascularization treatment. Most of these cases are due to non-performance of previous functional tests.

The difference between the two hospitals, a general and a cardiology hospital, was inherent in the population served, with similar adjusted appropriate use rates.

Author contributions

Conception and design of the research: Luciano LSC, da Silva RL; Acquisition of data: Luciano LSC, da Silva RL, Waldrich L, Panata L, Preve JC, Fattah T, Giuliano LC, Thiago LEKS; Analysis and interpretation of the data: Luciano LSC, da Silva RL, Lonero Filho OM; Statistical analysis: Luciano LSC, da Silva RL, Trombetta AP; Writing of the manuscript: Luciano LSC, da Silva RL; Critical revision of the manuscript for intellectual content: Luciano LSC, da Silva RL, Lonero Filho OM, Trombetta AP, Preve JC, Giuliano LC, Thiago LEKS.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any thesis or dissertation work.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Instituto de Cardiologia de Santa Catarina under the protocol number CAAE 83732218.8.0000.0113. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. As it was not an experimental study, the informed consent was dispensed by the Ethics Committee.

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